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ICAR - NRCB News

ICAR - National Research Centre for Banana
Tiruchirapalli - 620 102, Tamil Nadu, India

In this issue....

FROM THE DIRECTOR'S DESK

To commemorate the United Nations 'International Year of Soils – 2015, this newsletter highlights the research achievements made in banana fertilization and nutrition at this centre during last one decade. As banana is a nutrient exhaustive crop, farmers apply fertilizers indiscriminately which leads to impaired soil health and decline in productive potential. In ordeer to overcome the indiscriminate fertilizer application and increase the fertilizer use efficiency, ICAR-NRCB has come out with fertilizer tailoring equations for major commercial banana varieties, which have been validated in different AICRP centers and farmers fields in different agro-climatic conditions. By adopting these equations, the fertilizer requirement could be worked out for the targeted yield of farmers.

Salient research achievements of the Centre during the last six months is included in this ICAR-NRCB news which discovery of carrageenan as a low cost alternative for banana tissue culture, DNA profiling of plantain types using ISSR markers, production of banana hybrid by crossing cv. Nendran with Calcutta-4, cv. Rose and Pisang Lilin, validation of effective biocontrol agents against fusarium wilt disease of banana and production of banana central core stem based products.

I am glad to inform that ICAR-NRCB has got ISO 9001: 2008 certification on 31 March, 2016. Under 'Mera Gaon Mera Gaurav' theme, our institute has adopted 30 villages near Tiruchirapalli and issued soil health cards to farmers. Under 'Swachh Bharath' campaign, our institute has adopted a nearby village for its welfare and sanitation.

Soil Test-based Fertilizer Tailoring in Banana

In India, annually 30 million tons of banana is being produced from 8.3 lakh hectares, with the application of about 35 lakh tons of inorganic fertilizers. By the year 2020, India has to produce 50 million tons of bananas to cater to the needs of exploding population and for export purposes. For this, the requirement of inorganic fertilizers is estimated to be about 58 lakh tons. The cost of inorganic fertilizer is also increasing exorbitantly day by day. New economic reforms have suggested for the removal of subsidies given to inorganic fertilizers and in the present situation, the target of 50 million tons of banana production in 2020 is likely to be out of reach. At present, use of inorganic fertilizers is indiscriminate and imbalanced based on various blanket recommendations in different banana growing regions (1. Table). This practice has led to deterioration of soil health in many areas.

1. Table. Fertilizer recommendations for banana cultivation in different states of India

States	Nitrogen (g/plant)	Phosphorus (g/plant)	Potassium (g/plant)
Assam	240	128	128
Goa	400	200	400
Karnataka	180	150	186
Maharashtra	116	-	58
Kerala	228	228	186
Orissa	225	226	450
West Bengal	240	90	480
Gujarat	180	180	180
Tamil Nadu	110	35	330

Banana production at the current yield levels is not sustainable and in the long run, causes significant depletion of soil nutrients. There is a need to emphasize judicious application of inorganic fertilizers and integration of organic nutrients based on initial soil test values. Development of farmer-friendly nutrient adjustment equations is necessary to get targeted banana yield. Therefore, a soil test-crop response study based on soil fertility gradient approach was carried out at ICAR-NRCB in different commercial varieties of banana to develop quantitative basis for calculating the optimum dose of fertilizers for maximum profit, based on soil test in banana.

Experiments were conducted on Soil test - crop response (STCR) correlation. According to STCR plan, fertility gradient was created by applying graded doses of N, P and K fertilizers, for obtaining appreciable variation in soil fertility in the same field. After growing a maize crop as a nutrient gradient stabilizing crop, experiments on six banana varieties, *viz*., Karpuravalli, Poovan, Rasthali, Nendran, Ney Poovan and Grand Naine, were conducted as plant and ratoon crops in subsequent banana growing seasons. Soil samples were analyzed for available N, P and K. Leaf samples were collected and analyzed for N, P and K contents, with the help of nutrient uptake data and soil test values. The basic data (nutrient requirement in kg ton^{-1} of banana yield, per cent contribution of particular nutrient from soil, per cent contribution of particular nutrient from fertilizer and per contribution of a particular nutrient from organic manure) required for making fertilizer recommendations for different crop production levels were calculated by following procedures of Ramamoorthy *et al.* (1967).

After harvesting, bunch weight was recorded and total nutrient uptake was determined plot-wise. Post-harvest soil samples were collected and analyzed for available N, P and K status. Nutrient requirement (NR) in kg per ton of produce, the percent contribution from available soil nutrients (Cs), the percent contribution from the applied fertilizer nutrients (Cf) and the percent contribution from the organic sources (Co) were worked out by using STCR data. The experimental data of STCR studies provide a range in soil test values, nutrient uptake, yield, fertilizer and organic levels which enable for calculating the basic parameters as given below:

1. NR (kg t^{-1}) = {Total uptake of N/P/K by the crop (kg ha^{-1}) / Yield of crop (t ha^{-1})}

2. Cs (%) = {Total uptake of N/P/K in control plot (kg ha^{-1}) / Soil test value of N/P/K in control plot (kg ha^{-1})} X 100

3. Cf (%) = {(Total uptake of N/P/K in fertilized plot (kg ha^{-1}) - (Soil test value of N/P/K in fertilized plot (kg ha^{-1}) x Average Cs) / (Amount of fertilizer N/P/K applied (kg ha^{-1})} X 100

4. Co (%) = {(Total uptake of N/P/K in organic plot (kg ha^{-1}) - (Soil test value of N/P/K in organic plot (kg ha^{-1}) x Average Cs) / (Amount of organic nutrient applied (kg ha^{-1})} X 100

These parameters are then transformed to workable equations as given below:

$$FD = \{(NR \times 100\ T) / Cf\} - \{(Cs \times STV) / Cf\} - \{(Co \times O) / Cf\}$$

where, FD = Fertilizer nutrient dose (N or P_2O_5 or K_2O in kg ha^{-1})

T = Yield target (t ha^{-1})

STV = Soil Test Value of $N/P_2O_5/K_2O$ (kg ha^{-1})

O = N/P/K added through organics (kg ha^{-1})

Fertilizer tailoring equations

Nendran

FN = (29.8 x T) – (0.97 x SN) – (0.62 x ON)
FP = (5.45 x T) – (1.24 x SP) – (0.42 x OP)
FK = (57.92 x T) – (0.92 x SK) – (0.80 x OK)

Rasthali

FN = (18.34 x T) – (0.92 x SN) – (0.29 x ON)
FP = (2.77 x T) – (0.74 x SP) – (0.63 x OP)
FK = (39.85 x T) – (0.78 x SK) – (0.51 x OK)

Ney Poovan

FN = (19.0 x T) – (0.84 x SN) – (0.28 x ON)
FP = (2.41 x T) – (0.76 x SP) – (0.20 x OP)
FK = (33.10 x T) – (0.50 x SK) – (0.45 x OK)

Poovan

FN = (26.7 x T) – (0.76 x SN) – (0.29 x ON)
FP = (3.61 x T) – (0.73 x SP) – (0.38 x OP)
FK = (41.98 x T) – (0.96 x SK) – (0.49 x OK)

Karpuravalli

FN = (21.6 x T) – (0.83 x SN) – (0.29 x ON)
FP = (3.21 x T) – (0.76 x SP) – (0.22 x OP)
FK = (22.4 x T) – (0.59 x SK) – (0.32 x OK)

Grand Naine

FN = (8.80 x T) – (0.73 x SN) – (0.32 x ON)
FP = (0.84 x T) – (0.77 x SP) – (0.37 x OP)
FK = (11.21 x T) – (0.44 x SK) – (0.39 x OK)

Here, FN, FP and FK are nitrogen (N), phosphorus (P_2O_5) and potassium (K_2O) requirements (kg/ha) of banana cultivated in one hectare, respectively, through fertilizers. T is the target (tons/ha) of banana yield. SN, SP and SK are quantity (kg/ha) of nitrogen (N), phosphorus (P_2O_5) and potassium (K_2O) already existing in the soil, before application of fertilizer. ON, OP and OK are quantity (kg/ha) of nitrogen (N), phosphorus (P_2O_5) and potassium (K_2O) contributed from the recommended dose of organic manures applied to banana crop.

RESEARCH HIGHLIGHTS

Crop Improvement

Survey, collection and characterization of banana germplasm accessions

A total of 27 banana germplasm have been collected through exploration in Tripura and Nagaland and secondary source (BRS-Kannara, Kerala). Shoot tip cultures of 70 ITC accessions were collected from ICAR-NBPGR, New Delhi, and are being maintained in the tissue culture lab for further multiplication. Using IPGRI Musa descriptor, morpho-taxonomic characterization and descriptions of five accessions, namely, Kurangu Vazhai, Shasra Poovan, Safed Velchi, Dole and Pisang Berangan have been completed.

Improvement of Rasthali through induced mutagenesis

About 206 cultures of putative mutants of cv. Rasthali derived from 12 mutant lines (RM 36, 60, 74, 102, 133, 152, 176, 207, 214, 217, 219 and 230) are under *in vitro* screening with fusaric acid. Out of the 12 putative mutants with Fusarium wilt resistance which were mass multiplied, plants of eight putative mutants, namely 60, 74, 133, 176, 207, 217, 219 and 230, have been secondary hardened and ready for field planting.

Development of trait specific markers for Fusarium wilt resistance through association mapping studies in banana

Out of 54 core collection accessions representing genomic groups AA (16), BB (9), AB (5), AAA (10) and AAB (14) which were screened for Fusarium wilt (VCG 0124) under pot conditions, only Manohar (BB), Borkal Baista (BB) and *M. acuminata* ssp. *burmannica* (AA), were recorded resistant.

Use of Carrageenan as a low cost alternative in banana tissue culture

Use of Carrageenan, a gelling agent derived from a sea weed, *kappaphycus cottonii* as a low cost alternative for the routinely used gelling agent agar / phytagel substantially reduced the medium cost by 43-61% when compared to control (agar).

DNA profiling of plantain clones using ISSR markers

DNA profiles using ISSR markers were developed to distinguish morphologically similar clones of plantain *viz.* Nendran, Quintal Nendran and Swarnamukhi at early vegetative stages.

Evaluation of Nendran based progenies

Forty seven Nendran based progenies including 20 Nendran x cv. Rose, 12 Nendran x P.Lilin and 5 open pollinated Nendran (OPN) were obtained and planted in the field.

Crop Protection

Field management of fusarium wilt disease of banana cv. Grand Naine at farmer's field in Theni district indicated that plants treated with liquid formulation of endophytic *Bacillus flexus* + endophytic *Trichoderma asperellum* recorded the lowest incidence of Fusarium wilt disease (disease score of 1.7) with an average bunch weight of 44 kg compared to control (16.2 kg). Field evaluation of talc based formulation of effective endophytic and epiphytic fungal and bacterial isolates indicated that spraying of endophytic *Lysinibacillus sphaericus* + endophytic *Bacillus megatarium* recorded 77% reduction in leaf-spot disease severity and 15% increase in bunch weight compared to control.

Postharvest Technology

Development of banana central core stem based products

Soup mix and ice cream mix were developed by incorporating banana central core stem powder. Banana central core (stem) juice based syrup was developed by blending stem juice with sugar and citric acid having TSS content of 65° Brix and acidity of 1.0%.

Comparative Evaluation of Banana Central Core Stem powder and Corm Juice

Evaluation of central core stem powder of seven commercial varieties of banana indicated that cv. Rasthali had the highest amount of starch (10.66%), total carbohydrates (13%) and energy (52 kcal). Highest crude fiber was found with Saba and Mortaman. Out of six varieties of banana varieties evaluated for corm juice, Udhayam recorded maximum recovery (94.8%) followed by Nendran (91%) and Saba (88.55).

TRANSFER OF TECHNOLOGY

Radio talks

Name of the Scientist	Topic	Date of broadcast
Dr. M. Mayil Vaganan	Health benefits of banana fruit	1 March, 2016

Exhibitions participated

Name of the Event	Organiser / Venue	Date
Tuber crops food festival (Tuber food fest - 2015)	ICAR – CTCRI, Thiruvananthapuram, Kerala.	24–25 November, 2015
South zone Agri Expo - 2015	ANGRAU, Lam farm, Guntur, A.P.	19–21 December, 2015
Indian Science Congress	Govt. of India, Mysore, Karnataka.	3–7 January, 2016
Agri Expo - 2016	Pasumai Vikatan, Tiruchirapalli, T.N.	12–15 February, 2016
Farmers' interface meeting	ICAR – IIVR, Kushinagar, U.P.	18–20 February, 2016
Krishi Unnati Mela - 2016	Ministry of Agriculture & Farmers' Welfare and CII, ICAR – IARI, New Delhi.	19–21 March, 2016

Visitors at ICAR – NRCB stall during Krishi Unnati Mela

Dr. S. Ayyappan, DG, ICAR visit to ICAR –NRCB stall during Indian Science Congress

Trainings offered

On-campus

Title of the Training	Co-ordinator(s)	Date
Training on banana fig	Dr. K. N. Shiva	6 - 7 October, 2015
Improved scientific cultivation and value addition in banana. (Arunachal Pradesh, Nagaland and Tripura).	Dr. V. Kumar & Dr. P. Suresh kumar	14 - 19 October, 2015
Hands on training on banana tissue culture	Dr. M. S. Saraswathi	14 - 19 December, 2015
Training on banana fig, banana flour, banana flour based baby food and banana peel pickle	Dr. K.N. Shiva	15-16 December, 2015
Technical training programme on tissue culture of banana cv. Sabri	Dr. S. Uma & Dr. M. S. Saraswathi	28 January to 3 February, 2016
Training on banana fibre handicrafts	Dr. K. N. Shiva	30 January, 2016
Training on Post-harvest handling, packing, storage and ripening in banana for domestic and export markets	Dr. K. N. Shiva	23-25 February, 2016
Training on banana flour and banana flour based baby food	Dr. K. N. Shiva	2-3March, 2016

Participants of the hands on training on banana fibre handicrafts

Participants of the hands on training on banana tissue culture

Off-campus (Under TSP / NEH plan)

Title of the Training	Location	Date	No. of farmers participated
Improved scientific cultivation and value addition in Banana	ICAR, RC NEHR, AP Centre, Basar, Arunachal Pradesh	14 October, 2015	100
	SASRD, Nagaland University, Medzhiphema, Nagaland	16 October, 2015	100
	College of Agriculture, Agartala, Tripura	19 October, 2015	150

Human Resource Development

Training / Refresher course / Summer / Winter Institutes / Seminar / Conference / Symposia / Workshop attended by staff

Name of the Scientist	Name of the programme /Venue	Date
Dr. I. Ravi	Third International Plant Physiology Congress on "Challenges and strategies in Plant Biology Research" at Jawaharlal Nehru University, New Delhi	11-14 December, 2015
Dr. K. N. Shiva	Group interaction meeting by Banana farmers' producer company (BAPCO), Tirunelveli, T.N.	18 January, 2016
Dr. P. Giribabu	Interactive workshop on 'Harmonizing plant protection recommendations in Horticultural crops for South India', ICAR–IIHR, Bengaluru, Karnataka.	4-5 February, 2016
Dr. I. Ravi	"HortIP 2016" First annual review meeting. South Horticulture ZTMC,ICAR-IIHR, Bengaluru	8 February, 2016
Dr. M. S. Saraswathi	Training on Managing technology value chains, Administrative staff college of India, Hyderabad.	22-26 February, 2016

Awards

Name of the Scientist	Award received	Date
Dr. K. N. Shiva	Best poster presentation award at 50th Annual Convention of Indian Society of Agricultural Engineers held at OUAT, Bhubaneswar, Odhisha.	19–21 January, 2016

PUBLICATIONS

Research articles

- Backiyarani, S., Raja, K., Uma, S., Chandrasekar, A., Saraswathi, M.S., Sundararaju, P. and Mayilvaganan, M. 2016. Genome and transcriptome-wide analysis of WRKY transcription factors for *Pratylenchus coffeae* resistance in banana. *Acta Horticulturae* DOI: 10.17660/ActaHortic.2016.1114.17
- Krishna Surendar, K., Durga Devi, D., Jeyakumar, P., Velayudham, K. and Ravi, I. 2015. Changes in Proline and Polyphenol oxidase enzyme activity in some banana cultivars and hybrids under water stress. *Genomics and Applied Biology* 6(4): 1–6.
- Saraswathi, M.S., Uma, S., Kannan, G., Selvasumathi, M., Mustaffa, M.M. and Backiyarani, S. 2016. Cost-effective tissue culture media for large-scale propagation of three commercial banana (*Musa* spp.) varieties. *The Journal of Horticultural Science and Biotechnology* 91:1, 23-29.
- Uma, S., Saraswathi, M.S., Backiyarani, S. and Durai, P. 2015. Banana breeding — A brief review. *International Journal of Innovative Horticulture* 4(1): 11-19.
- Uma, S., Backiyarani, S., Saravanakumar, A.S., Chandrasekar, A., Thangavelu, R. and Saraswathi, M.S. 2016. Identification of *Mycosphaerella eumusae* responsive unique genes / transcripts from a resistant banana cultivar. *Acta Horticulturae*, DOI: 10.17660/ *Acta Horticulturae* 2016.1114.16

CONSULTANCY SERVICES AND COMMERCIALIZATION OF TECHNOLOGIES

- At ICAR-NRCB's Lab accreditation facility for virus indexing and genetic fidelity testing of tissue culture plants, 874 batches of tissue culture plants (cvs. Grand Naine, Williams, Robusta, Neypoovan, Red banana, Quintal Nendran, etc.) were tested for their genetic fidelity using SSR and ISSR markers and reports issued.
- Six value added products/technology namely banana fig, banana flour, flour based baby food, health drink, peel pickle, post-harvest handling, packing, storage and ripening in banana for domestic and export markets were commercialized.

IRC / RAC / IMC MEETINGS

RAC Meeting

The Research Advisory Committee (RAC) meeting was held on 27–28 October, 2015 under the chairmanship of Dr. S.N.Pandey. The RAC members visited the research farm where scientists explained their experimental trials. Dr. B. Padmanaban, Acting Director, presented the salient research achievements of ICAR–NRCB during the last year and the action taken report on the recommendations of the last RAC. The scientists presented their research achievements and fruitful discussions were held for research improvement.

IMC Meeting

The 21st Institute Management Committee (IMC) of ICAR - NRCB was held under the chairmanship of Dr. B. Padmanaban, Acting Director on 29 March, 2016. Members of the IMC are as follows.

Chairman	Dr. B. Padmanaban, Acting Director, ICAR – NRCB, Tiruchirapalli
Member	Dr. Vikramaditya Pandey, Principal Scientist, ICAR, New Delhi
Member	Dr. S. Devasahayam, Head (Crop Protection), ICAR – IISR, Calicut
Member	Dr. N. Bakthavatsalam, Principal Scientist & Head (Division of Insect Ecology), ICAR – NBAIR, Bengaluru
Member	Dr. S. Sriram, Principal Scientist, ICAR – IIHR, Bengaluru

Member	Dr. (Mrs.) Anuradha Agrawal, Principal Scientist, ICAR – NBPGR, New Delhi
Member	The Commissioner of Horticulture & Plantation Crops, Govt. of Tamil Nadu, Chennai
Member	The Additional Director of Horticulture (Fruits), Dept. of Horticulture, Government of Karnataka, Bengaluru
Member	Dean (Horticulture), Tamil Nadu Agriculture University, Coimbatore
Member	Finance & Accounts Officer, ICAR – CIBA, Chennai
Member Secretary	Mr. B. Sathish, SAO, ICAR – NRCB, Tiruchirapalli

AICRP Fruits Meet

Annual group discussion meeting on AICRP – Fruits was held at PAU, Ludhiana from 3 to 6, March, 2016. ICAR – NRCB scientists *viz.,* Drs. B. Padmanaban, S. Uma, R. Selvarajan, V. Kumar, K. J. Jeyabaskaran and P. Suresh Kumar attended the meeting.

OTHER INFORMATION

Farmer's interface meeting

ICAR – NRCB, in collaboration with ICAR-IIVR, Varanasi organized an one day banana farmers' interface meeting at ICAR-IIVR KVK, Kushinagar on 19 February, 2016. Around 150 banana farmers from Kushinagar District were participated in the meet. Dr. B. Padmanaban, Acting Director, ICAR - NRCB, Tiruchirapalli presided over the function and Dr. B. Singh, Director, ICAR-IIVR, Varanasi was chief guest of the function. Er. Rajesh Yadav, DGM, NABARD was guest of honour. Principal Scientists Dr. R. Thangavelu and Dr. V. Kumar, ICAR-NRCB presented the improved plant protection technologies. Ten Progressive banana growers of Kushinagar were honoured with recognition certificate.

Swachh Bharath

ICAR-NRCB celebrated 'Swachh Bharat fortnight' from 2 - 17 October, 2015. Institute premises, farm and staff quarters were cleaned by staff and poster and slogan competitions were conducted. Under this cleanliness drive, ICAR–NRCB has adopted Keerikalmedu, the village near ICAR-NRCB research farm on March 19, 2016. The inauguration function was presided over by Dr. B. Padmanaban Acting Director and President, Village Panchayat.

Vigilance Awareness Week

Vigilance awareness week was observed at ICAR-NRCB from 26 to 31 October, 2015. On this occasion, the staff of the institute took a pledge on 26 October, 2015. Various competitions were conducted.

Rastriya Ekta Divas

The staff of ICAR–NRCB observed Rastriya Ekta Divas on 31 October, 2015 to commemorate the birth anniversary of Sardar Vallabhbhai Patel and took pledge for national unity.

Communal Harmony Campaign

ICAR–NRCB celebrated 'Communal harmony campaign' from 19 to 25 November, 2015 and conducted various competitions for children of nearby schools.

Constitution Day

Staff of ICAR - NRCB celebrated 'Constitution Day' on 26 November, 2015 to commemorate 125th birth anniversary of Dr. B. Ambedkar. On this occasion preamble of the constitution was recited.

World Soil Day

World Soil Day was celebrated on 5 December, 2015 at this centre. The event was presided over by Dr. P. Pandiyarajan, Dean, ADAC & RI, Tiruchirapalli, TNAU. He urged the famers to conduct periodical soil tests for productive farming. Dr. K. J. Jeyabhaskaran, Principal Scientist, delivered a technical lecture on soil, its properties, nutrients and its impact on crop growth and yield. As part of this celebration, soil health cards were distributed to farmers. Dr. B. Padmanaban, Acting Director, ICAR - NRCB encouraged the farmers to get their soils tested at this centre.

Jai Kisan Jai Vigyan Week

Farmer's Sangosti was organized by ICAR- NRCB as part of Jai Kisan Jai Vigyan Week celebrations at Nachalur village, Karur District, Tamil Nadu, on 28 December, 2015. Dr. B. Padmanaban, Acting Director and team of Scientists comprising Drs. R. Thangavelu, K.J. Jeyabaskaran, K.N. Shiva and P. Suresh Kumar interacted with the farmers.

National Science Day

ICAR-NRCB celebrated "National Science Day" on 29 February, 2016 with an objective to expose the students and general public to the recent research developments in banana and to create awareness and motivation among school students. Around 350 students visited the exhibition.

ISO certification

As part of our efforts to establish and follow Quality Management Systems procedures, certification body auditors from Star Certification International, Bengaluru, visited our institute on 31 March, 2016. After checking various records, documents and systems maintenance, the auditors recommended award of ISO 9001:2008 certification to ICAR-NRCB.

Obituary

We condole the untimely demise of our colleague, Mr. M. Devarajan, Lower Division Clerk, who passed away on 24 March, 2016. He is survived by his wife and two daughters.

School students visit at ICAR-NRCB during National Science Day

Dignitaries at Banana farmers' interface meeting held at ICAR-IIVR KVK, Kushinagar on 19 February, 2016.

Visitors

About 2800 visitors comprising banana farmers/entrepreneurs/horticultural/agricultural officers/college students visited ICAR-NRCB and they were briefed about improved production, protection technology, postharvest management and value addition of banana.

Distinguished Visitor

Name, Designation and Address	Date
Dr. T. Prabhu Shankar, IAS, Assistant Secretary, DARE, New Delhi	9 November, 2015

हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद
Agrisearch with a human touch

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